(I) CLAIMS

1. A projection lithography system, for curved surface lithography, having a number of required transmissive elements in a light path controlled by projection optics and illumination optics

characterized in that:

the illumination optics has means to form an illumination compensator 'Zerogon' having the zero-power aggregate optical effect of two closely-spaced identical meniscus elements back-to-back.

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2. A projection lithography system for imaging a microelectronics pattern according to Claim 1

further characterized by:

a) a curved substrate (3);

b) a curved mask (2), whose size and curvature are related to the size and curvature of the curved substrate (3);

c) radiation means (7):

d) projection means (5); and

e) scanning means (8), to present, for scanning, both said curved mask (2) and said curved substrate (3) for imaging mask to substrate via said projection means (5), with means to move said projection means (5); whereby the curved mask pattern is imaged onto the curved substrate surface, and the substrate surface remains within the depth-of-focus of said projection means and said scanning polygon remains at substantially the same size: and

f) Zerogon means (1) in the illumination light path supporting said mask means (2) to transmit the scanning beam undistorted in its shape and direction of propagation.

3. A projection lithography system according to Claim 2, wherein said curved mask (2) is a photo-opaque pattern on the curved exit surface of said Zerogon means (1).

4. A projection lithography system according to Claim 2, wherein said curved mask (2) is identical in size and shape but complementary in convexity orientation to said curved substrate (3).

5. A projection lithography system according to Claim 4,

further characterized by

means to provide compensating motion to said projection means (5), to maintain the total track length to within the depth-of-focus; and

zoom capability in said condensing means, calculated to keep the illumination beam focused on said curved mask with constant size.

6. A projection lithography system according to Claim 4,

further characterized in that

said Zerogon has two oppositely-oriented optical elements aggregating zero power, having an entry face and an exit face; and

a curved patterning mask positioned directly on the exit face of said Zerogon.

7. A projection lithography system according to Claim 6,

further characterized in that

said Zerogon means has a patterning mask element positioned in the projection beam path so that Zerogon elements when aggregated form a zero-power refractive device to direct the mask pattern forward.

8. A projection lithography system according to Claim 7,

further characterized in that

said Zerogon has a concave entry surface and a concave exit surface.

9. A projection lithography system according to Claim 7,

further characterized in that

said Zerogon has a convex entry surface and a convex exit surface.

10. A projection lithography system having a Zerogon compensator as mask support for a flexible film curved mask.

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11. A projection lithography system having a Zerogon as mask support for a flexible film curved mask, and having a locking band to hold said flexible film mask in place on said Zerogon.

12. A projection lithography system according to Claim 7,

characterized by:

a) an optically transparent mask body having surface curvature identical to known curvature of the substrate, having a photo-opaque pattern layer on said
20 surface; and

b) means forming a Zerogon (1) with said mask body by mounting an oppositely oriented optically transparent compensating body in close proximity in the light path.

13. A projection lithography system for imaging a pattern from a curved mask onto a curved substrate, thereby maintaining the image within the depth of focus of the projection optics, using scanning techniques,

characterized by:

a) a curved substrate (3) mounted on a scanning platform;

b) a curved transmissive mask (2), having an inverted orientation with respect to said curved substrate (3), mounted on said scanning platform;

c) radiation means (7);

d) projection means (5);

e) scanning means (8), to present, for scanning and imaging a pattern from said curved mask (2) to curved substrate (3) via said projection means (5); and

f) Zerogon means (1) to minimize the effects of image anomalies related to curved mask (2) and support.

14. A curved mask (2) for a projection lithography system, for use in imaging a pattern from its surface to the surface of a curved substrate of known curvature characterized by:

a) an optically transparent mask body having surface curvature identical to said known curvature of the substrate, having a photo-opaque pattern layer on said surface; and

b) means forming a Zerogon (1) with said mask body by mounting an oppositely oriented optically transparent compensating body in close proximity in the light path.

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15. A curved mask (2) according to Claim 14, wherein said optically transparent mask body and said optically transparent compensating body are fused silica.

16. A projection lithography mask according to Claim 15 having a photo-opaque pattern layer is selected from aluminum or chrome on said curved mask (2).

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17. A projection lithography mask made by the following contact lithography / non-contact lithography process, starting with a planar mask of metal-on-quartz;

1) Place a layer of photo-active material on aluminized polypropylene in contact with said planar mask;

2) Expose to imaging radiation;

3) Process to provide a pattern of aluminum on a flexible film of polypropylene;

4) Place the patterned aluminum-on-polypropylene in contact with a hard, curved optically transparent blank projection mask resting on a Zerogon.

18. A projection lithography mask made by the process of Claim 17, wherein the hard, curved optically transparent blank of step 4 is precooked with a metallized layer and a photoactive resist layer, to serve as an intermediate, and steps are added as follows:

5) Expose for imaging defined by the pattern;

6)' Process to develop the pattern as a metal-on-quartz curved mask; and

7) Replicate by projection printing using said metal-on-quartz curved projection mask to fabricate a metal-on-quartz curved projection mask.

19. A projection lithography scanning system for imaging a curved mask onto a curved substrate, with provisions for control of defocus, which must be minimized for scanning systems, by continuously adjusting the position of the projection lens along its axis during scanning, with the adjustments related to changes of topography of the curved mask and substrate, such that the object distance and image distance for the conjugate points at the center of the lens field remain constant during scanning, together with means to keep the size and shape of the scanning beam constant on the curved mask and curved substrate.

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20. A Zerogon

comprising

paired identical meniscus lenses arranged to carry a patterned mask for input to a projection lens so as to transmit the illumination beam without deviation and displacement to ensure high resolution pattern transfer in curved mask lithography.

21. A Zerogon according to Claim 20,

20 arranged to serve as a curved mask / mask support subassembly for use in projection lithography, having two meniscus elements, one of which meniscus elements having a curved outer face equipped with a similarly-curved photo-opaque pattern means.

22. A Zerogon according to Claim 21, having a concave outer surface carrying a photo-opaque pattern.

23. A Zerogon according to Claim 21 having a convex outer surface carrying a photo-opaque pattern.

24. A Zerogon having back-to-back complementary lens elements serving as a zero-power optical device, at a position with respect to the optical axis in the optical system to transmit collimated and uncollimated beams without deviation and without shift from the line of propagation.